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09/528,678	03/20/2000	Albert M. Chan	MIT8755	5588

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EXAMINER	
ODOM, CURTIS B	
ART UNIT	**PAPER NUMBER**
2611	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	**Application No.** 09/528,678	**Applicant(s)** CHAN ET AL.
	Examiner Curtis B. Odom	**Art Unit** 2634

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 10 May 2006.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-32 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-32 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed 5/10/2006 have been fully considered but they are not persuasive. Applicant discloses that Tan et al. (U. S. Patent No. 6, 226, 323) does not disclose causally filtering tentative decisions. However, in column 25, lines 4-20 of Tan et al., the applicant states that Tan et al. discloses N tentative (symbolic) decisions are processed by the second filter (DFE 322) anticausally. In column 25, lines 4-20, Tan et al. also states that the **same** tentative (symbolic) decisions are processed by a set of "M+1 causal coefficients" in the same second filter (DFE 322). Thus, it is the understanding of the examiner that the second filter (DFE 322) causally and anticausally filters the tentative decisions. Applicant's arguments with respect to claims 1-32 regarding the limitations "multiple non-simultaneous passes through the data" have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-7, 9-12, 15-23 25-28, 31, and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tan et al. (previously cited in Office Action 1/26/2005) in view of Batruni (U. S. Patent No. 5, 297, 166) and in further view of Agazzi et al. (U. S. Patent No. 6, 304, 598).

Regarding claim 1, Tan et al. discloses an iterative equalizer (Figs. 24 and 25) for a data communication system for recovering received data transmitted over a data channel comprising:

a first filter (Fig. 25, block 328, column 24, line 21-column 25, lines 28) for filtering a received data according to first filter parameters to generate first-filtered data;

a combiner (Fig. 25, summer after block 328, column 24, line 21-column 25, line 28) for modifying the first-filtered data with second-filtered data to generated modified data;

a decision device (Fig. 25, block 320, column 24, line 21-column 25, line 62, see also Fig. 24, block 320) for generating modified tentative decisions on all the data in the block (symbol) based on the modified data, the modified tentative decisions being modified with respect to tentative decisions of a previous iteration (column 24, line 53-column 25, line 20); and

a second filter for causally and anticausally (Fig. 25, block 322, column 24, line 21-column 25, line 28) for filtering the block of tentative (symbolic) decisions from a previous iteration according to second filter parameters to generate the second-filtered data;

wherein said received block of data is filtered more than once by multiple passes (column 17, lines 36-63, wherein the first pass generates the tentative decisions and the second pass cancels the ISI using the tentative decisions) through the data, each pass and the first and second filter parameters are based on the received data (column 25, lines 21-28) and the intersymbol interference is removed from the modified data in a nonlinear manner (Abstract), wherein DFE is a known non-linear equalization process.

Tan et al. does not explicitly disclose the second filter is a linear filter, the received block of data is filtered more than once by multiple non-simultaneous passes through the data, each pass comprising both a first filter and a second filter, or the second filter producing an estimate of ISI wherein the modified tentative decisions are used to subtract out an estimate of ISI. However, Tan et al. does disclose that the second filter (decision feedback filter) can be implemented using a variety of different specifications (column 18, lines 3-29). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made that since the complexity of the filter depends on the number of coefficients multiplication operations, and filter length, that implementing a linear filter as the second filter would reduce the complexity and hardware of the second filter performing the filter functions (column 18, lines 16-29).

Batruni discloses performing multiple equalization iterations (passes) on a received data signal through a decision feedback filter (see column 8, lines 45-57), wherein the iteration generate error signals based on the used filter coefficients. Therefore, it would have been obvious to one skilled in the art at the time the invention was made to modify the adaptive filters of Tan et al. with the teachings of Batruni and incorporate a multiple iteration updating method including multiple passes through filters since Batruni states this method allows updating of filter coefficients and achieves more rapid convergence when implementing Widrow-Hoff least-mean squared adaptation processes (see column 6, lines 16-21).

Agazzi et al. further discloses an adaptive feedback filter (Fig. 10, block 100) which produces an estimate of ISI, wherein the tentative (soft) decisions applied to the filter are used to generate an estimate of ISI which is canceled (subtracted) from the received signal (see column

9, lines 20-30). Therefore, it would have been obvious to one skilled in the art at the time the invention was made to modify the second filter of Tan et al. and Batruni with the teaching the adaptive feedback filter of Agazzi in order to remove ISI from a received signal.

Regarding claim 2, which inherits the limitations of claim 1, Tan et al. discloses the first and second filter parameters are modified at each iteration (column 25, lines 21-28).

Regarding claim 3, which inherits the limitations of claim 1, Tan et al. discloses the equalizer is fractionally-spaced in that the received data is sampled at a higher rate than a symbol rate associated with the received data (column 10, lines 39-49).

Regarding claim 4, which inherits the limitations of claim 1, Tan et al. discloses the received data comprises symbol data (column 25, lines 1-28).

Regarding claim 5, which inherits the limitations of claim 1, Tan et al. discloses the first and second filter parameters are modified at each iteration according to channel parameters (path metrics) that are re-estimated at each iteration based on the received data (column 24, line 52-column 25, line 28).

Regarding claim 6, which inherits the limitations of claim 1, Tan et al. discloses the received data is encoded (column 22, line 54-column 23, line 20) and the decision device can comprise an error correction decoder (column 4, lines 46-62). Tan et al. does not disclose using error-correction coding or an error-correction encoder for the encoding the tentative decisions. However, it would have been obvious to one skilled in the art at the time the invention was made that the encoder and decoder Tan et al. could have been modified to use error correction encoding and error correction encoding for the tentative decisions. Error correction encoding

and decoding detects and corrects errors in transmitted data. This improves data reliability and data transmission rates in the presence of noise and interference.

Regarding claim 7, which inherits the limitations of claim 1, Tan et al. discloses the first and second filters comprise filter types selected from the group of filter types consisting of: time-variant, time-invariant, IIR, and FIR filters (column 17, line 64-column 18, line 2, wherein the filters are time-variant depending on the baud rate).

Regarding claim 9, Agazzi discloses a received with an equalizer wherein the received data comprises combined data for a plurality of users (FEXT impairment signals) see column 8, lines 37-46, and wherein the equalizer further comprises a plurality of second filters for the second-filtering the tentative decisions from a previous iteration (Fig. 10, block 100, column 9, lines 13-30). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention to include this feature in order to improve receiver diversity which would allow the receiver to be implemented into multi-user communication systems. The plurality of filters would reduce multi-user interference (FEXT impairment signals) which allows for an increase in system capacity and allows signal decoding to be carried out efficiently.

Regarding claim 10, which inherits the limitations of claim 1, Tan et al. discloses the first filter, combiner, decision device, and second filter are distributed among a data channel transmitter and receiver (column 2, lines 11-28 and column 6, lines 32-48).

Regarding claim 11, Tan et al. discloses an iterative equalizer (Figs. 24 and 25) for a data communication system for recovering received data transmitted over a data channel comprising:

a first linear filter (Fig. 25, block 328, column 24, line 21-column 25, lines 28) for filtering a received data according to first filter parameters to generate first-filtered data;

a combiner (Fig. 25, summer after block 328, column 24, line 21-column 25, line 28) for modifying the first-filtered data with second-filtered data to generated modified data;

a decision device (Fig. 25, block 320, column 24, line 21-column 25, line 62, see also Fig. 24, block 320) for generating modified tentative decisions on all data in the block (symbol) based on the modified data, the modified tentative decisions being modified with respect to tentative decisions of a previous iteration (column 24, line 53-column 25, line 20); and

a second filter for causally and anticausally (Fig. 25, block 322, column 24, line 21-column 25, line 28) filtering the block of tentative decisions from a previous pass (column 23, lines 37-44, past decision during first pass) according to according to second filter parameters to generate the second-filtered data;

wherein the first and second filter parameters are based on an estimate of channel parameters (column 25, lines 21-28) , and wherein the decision device can comprise an error-correction decoder (column 4, lines 46-62), and ISI is removed in a non-linear manner (Abstract), wherein DFE is a known non-linear equalization process.

Tan et al. does not explicitly disclose the second filter is a linear filter. However, Tan et al. does disclose that the second filter (decision feedback filter) can be implemented using a variety of different specifications (column 18, lines 3-29). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made that since the complexity of the filter depends on the number of coefficients multiplication operations, and filter length, that implementing a linear filter as the second filter would reduce the complexity and hardware of the second filter performing the filter functions (column 18, lines 16-29).

Tan et al. also does not explicitly disclose using error-correction coding or an error-correction encoder for the encoding the tentative decisions. However, Tan et al. does disclose the received data is encoded (column 22, line 54-column 23, line 20) and the decision device can comprise an error correction decoder (column 4, lines 46-62). Therefore, it would have been obvious to one skilled in the art at the time the invention was made that the encoder and decoder Tan et al. could have been modified to use error correction encoding and error correction encoding for the tentative decisions. Error correction encoding and decoding detects and corrects errors in transmitted data. This improves data reliability and data transmission rates in the presence of noise and interference.

Tan et al. also does not disclose the received block of data is filtered more than once by multiple non-simultaneous passes through the data, each pass comprising both a first filter and a second filter, or the second filter producing an estimate of ISI wherein the modified tentative decisions are used to subtract out an estimate of ISI.

Batruni discloses performing multiple equalization iterations (passes) on a received data signal through a decision feedback filter (see column 8, lines 45-57), wherein the iteration generate error signals based on the used filter coefficients. Therefore, it would have been obvious to one skilled in the art at the time the invention was made to modify the adaptive filters of Tan et al. with the teachings of Batruni and incorporate a multiple iteration updating method including multiple passes through filters since Batruni states this method allows updating of filter coefficients and achieves more rapid convergence when implementing Widrow-Hoff least-mean squared adaptation processes (see column 6, lines 16-21).

Agazzi et al. further discloses an adaptive feedback filter (Fig. 10, block 100) which produces an estimate of ISI, wherein the tentative (soft) decisions applied to the filter are used to generate an estimate of ISI which is canceled (subtracted) from the received signal (see column 9, lines 20-30). Therefore, it would have been obvious to one skilled in the art at the time the invention was made to modify the second filter of Tan et al. and Batruni with the teaching the adaptive feedback filter of Agazzi in order to remove ISI from a received signal.

Regarding claim 12, which inherits the limitations of claim 11, Tan et al. further discloses the first and second filter parameters are modified at each iteration (column 25, lines 21-28).

Regarding claim 15, Tan et al. discloses an iterative equalizer (Figs. 24 and 25) for a data communication system for recovering received data transmitted over a data channel comprising:

a first linear filter (Fig. 25, block 328, column 24, line 21-column 25, lines 28) for filtering a block of received data according to first filter parameters to generate first-filtered data;

a combiner (Fig. 25, summer after block 328, column 24, line 21-column 25, line 28) for modifying the first-filtered data with second-filtered data to generated modified data;

a decision device (Fig. 25, block 320, column 24, line 21-column 25, line 62, see also Fig. 24, block 320) for generating modified tentative decisions based on the modified data, the modified tentative decisions being modified with respect to tentative decisions of a previous iteration (column 24, line 53-column 25, line 20); and

a second filter for causally and anticausally (Fig. 25, block 322, column 24, line 21-column 25, line 28) filtering the block of tentative decisions from a previous pass (column 23, lines 37-44, past decision during the first pass) according to second filter parameters to generate the second-filtered data;

wherein the received block of data is filtered more than once by multiple passes through the data (column 17, lines 36-63, wherein the first pass generates the tentative decisions and the second pass cancels the ISI using the tentative decisions), each pass and the first and second filter parameters are based on an estimate of channel parameters (column 25, lines 21-28) and wherein the equalizer is fractionally space in that received data is sampled at a higher rate than a symbol rate associated with the received data (column 10, lines 39-49) so that intersymbol interference is removed from the modified data in a nonlinear manner (Abstract), wherein DFE is a known non-linear equalization process.

Tan et al. does not explicitly disclose the second filter is a linear filter, the received block of data is filtered more than once by multiple non-simultaneous passes through the data, each pass comprising both a first filter and a second filter, or the second filter producing an estimate of ISI wherein the modified tentative decisions are used to subtract out an estimate of ISI. However, Tan et al. does disclose that the second filter (decision feedback filter) can be implemented using a variety of different specifications (column 18, lines 3-29). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made that since the complexity of the filter depends on the number of coefficients multiplication operations, and filter length, that implementing a linear filter as the second filter would reduce the complexity and hardware of the second filter performing the filter functions (column 18, lines 16-29).

Batruni discloses performing multiple equalization iterations (passes) on a received data signal through a decision feedback filter (see column 8, lines 45-57), wherein the iteration generate error signals based on the used filter coefficients. Therefore, it would have been

obvious to one skilled in the art at the time the invention was made to modify the adaptive filters of Tan et al. with the teachings of Batruni and incorporate a multiple iteration updating method including multiple passes through filters since Batruni states this method allows updating of filter coefficients and achieves more rapid convergence when implementing Widrow-Hoff least-mean squared adaptation processes (see column 6, lines 16-21).

Agazzi et al. further discloses an adaptive feedback filter (Fig. 10, block 100) which produces an estimate of ISI, wherein the tentative (soft) decisions applied to the filter are used to generate an estimate of ISI which is canceled (subtracted) from the received signal (see column 9, lines 20-30). Therefore, it would have been obvious to one skilled in the art at the time the invention was made to modify the second filter of Tan et al. and Batruni with the teaching the adaptive feedback filter of Agazzi in order to remove ISI from a received signal.

Regarding claim 16, which inherits the limitations of claim 15, Tan et al. discloses the first and second filter parameters are modified at each iteration (column 24, line 52-column 25, line 28).

Tan et al. does not explicitly disclose the second filter is a linear filter. However, Tan et al. does disclose that the second filter (decision feedback filter) can be implemented using a variety of different specifications (column 18, lines 3-29). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made that since the complexity of the filter depends on the number of coefficients multiplication operations, and filter length, that implementing a linear filter as the second filter would reduce the complexity and hardware of the second filter performing the filter functions (column 18, lines 16-29).

Regarding claims 17-23, 25-28, 31, and 32, the claimed method includes features corresponding to subject matter mentioned in the above rejection of claims 1-7, 9-12, 15, and 16, which is applicable hereto.

4. Claims 8, 13, 14, 24, 29, and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tan et al. (previously cited in Office Action 1/26/2005) in view of Batruni (U. S. Patent No. 5, 297, 166), in further view of Agazzi et al. (U. S. Patent No. 6, 304, 598), and in further view of Meehan (previously cited in Office Action 12/12/03)

Regarding claim 8, which inherits the limitations of claim 1, Tan et al., Batruni, and Agazzi et al disclose all the limitations of claim 8 (see rejection of claim 1), except the received data comprises a plurality of received signals received over a plurality of data channels, and wherein the equalizer comprises a plurality of first filters corresponding to the plurality of channels and the received block of data is filtered more than once by multiple non-simultaneous passes through the data, each pass comprising both a first filter and a second filter.

However, Meehan discloses an equalizer (Fig. 1) wherein the received data comprises a plurality of received signals (column 2, lines 9-34) received over a plurality of data channels, and wherein the equalizer comprises a plurality of first filters (Fig. 1, blocks 232, 228, 248, and 254) corresponding to the plurality of channels. Therefore, it would have been obvious to one of ordinary skill in the art to modify the receiver and equalizer of Tan et al., Batruni, and Agazzi et al. with the teachings of Meehan in order to improve receiver diversity which would allow the receiver to be implemented into multi-user communication systems. The plurality of filters would reduce multi-user interference which allows for an increase in system capacity and allows signal decoding to be carried out efficiently and accurately.

Regarding claim 13, Tan et al., Batruni, and Agazzi et al. discloses all the limitations of claim 13 (see rejection of claim 1) except the data is transmitted over a plurality of data channels wherein the received data comprises a plurality of received signals received over a plurality of data channels, and wherein the equalizer further comprises a plurality of first filters corresponding to the plurality of channels.

However, Meehan discloses an equalizer (Fig. 1) wherein the received data comprises a plurality of received signals (column 2, lines 9-34) received over a plurality of data channels, and wherein the equalizer comprises a plurality of first filters (Fig. 1, blocks 232, 228, 248, and 254) corresponding to the plurality of channels. Therefore, it would have been obvious to one of ordinary skill in the art to modify the receiver and equalizer of Tan et al., Batruni, and Agazzi et al. with the teachings of Meehan in order to improve receiver diversity which would allow the receiver to be implemented into multi-user communication systems. The plurality of filters would reduce multi-user interference which allows for an increase in system capacity and allows signal decoding to be carried out efficiently and accurately.

Regarding claim 14, which inherits the limitations of claim 13, Tan et al. further discloses the first and second filter parameters are modified at each iteration (column 25, lines 21-28).

Regarding claim 24, which inherits the limitations of claim 17, Tan et al., Batruni, and Agazzi et al. disclose all the limitations of claim 24 (see rejection of claim 17), except the received data comprises a plurality of received signals received over a plurality of data channels, and wherein the equalizer comprises a plurality of first filters corresponding to the plurality of channels.

However, Meehan discloses an equalizer (Fig. 1) wherein the received data comprises a plurality of received signals (column 2, lines 9-34) received over a plurality of data channels, and wherein the equalizer comprises a plurality of first filters (Fig. 1, blocks 232, 228, 248, and 254) corresponding to the plurality of channels. Therefore, it would have been obvious to one of ordinary skill in the art to modify the receiver and equalizer of Tan et al., Batruni, and Agazzi et al. with the teachings of Meehan in order to improve receiver diversity which would allow the receiver to be implemented into multi-user communication systems. The plurality of filters would reduce multi-user interference which allows for an increase in system capacity and allows signal decoding to be carried out efficiently and accurately.

Regarding claims 29 and 30, the claimed method includes features corresponding to subject matter mentioned in the above rejection of claims 13 and 14 which is applicable hereto.

Conclusion

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Curtis B. Odom whose telephone number is 571-272-3046. The examiner can normally be reached on Monday- Friday, 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jay Patel can be reached on 571-272-2988. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Curtis Odom
July 23, 2006